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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/797,224	03/10/2004	Zhen-Cheng Wu	252011-2000	6896

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EXAMINER

SANDVIK, BENJAMIN P

ART UNIT	PAPER NUMBER
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2826

DATE MAILED: 05/19/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

8m

Office Action Summary	Application No.	Applicant(s)	
	10/797,224	WU ET AL.	
	Examiner	Art Unit	
	Ben P. Sandvik	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-40 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-40 is/are rejected.
- 7) ☒ Claim(s) 12, 27, 39 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____. |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date ____. | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

Drawings

The drawings are objected to because in Figure 2 the thickness measurement T2 is incorrectly labeled for the first etch stop layer, and vice-versa. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

Claims 12, 27, and 39 are objected to because of the following informalities:
claim 12 sets forth the first etch stop layer as SiC and the second etch stop layer as

SiO₂, which is contrary to what is disclosed in the specification on page 14 lines 1-5.

The examiner assumed that the specification has the correct configuration for the composite etch stop layer and examined claim 12 based on this assumed configuration.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4, 6, 7, 11, 13-18, 30, 31, 33, 34, 38, and 40 are rejected under 35 U.S.C. 102(b) as being anticipated by Bao et al (U.S. Patent #6455417).

With respect to **claims 1, 14, 15, and 29**, Bao teaches a semiconductor substrate (Fig. 5, 10), a first copper layer formed overlying the semiconductor substrate (Fig. 5, 12), an etch stop layer formed overlying the first metal layer and the semiconductor substrate (Fig. 5, 14a), a dielectric layer formed overlying the etch stop layer (Fig. 5, 16a), a second copper layer penetrating the dielectric layer and the etch stop layer and electrically connected to the first metal layer (Fig. 5, 32), wherein the etch stop layer has a dielectric constant smaller than 3.5 (Col 6 Ln 34-38, physical property of carbon doped silicon nitride and carbon doped silicon oxide), and wherein the dielectric layer has a dielectric constant smaller than 3.0 (Col 8 Ln 38-42).

With respect to **claims 2, 16, and 30**, Bao teaches an etch stop layer with a compressive stress of $0-1 \times 10^9$ dynes/cm² (inherent property of SiCN).

With respect to **claims 3, 17, and 30**, Bao teach a dielectric layer with a tensile stress approximating to the compressive stress of the etch stop layer (inherent properties of **SiCN** and spin-on-glass).

With respect to **claim 4, 18, and 31**, Bao teaches a dielectric layer with a film hardness greater than 0.2 GPa and an elastic modulus greater than 5 GPa (inherent properties of spin-on-glass).

With respect to **claim 6**, Bao teaches that both the first metal layer (Col 5 Ln 62) and the second metal layer (Col 11 Ln 52) are copper layers.

With respect to **claims 7, 21, and 34**, Bao teaches an etch stop layer is a composite film comprising a first etch stop layer and a second etch stop layer, in which the first etch stop layer is formed overlying the second etch stop layer.

With respect to **claims 11, 26, and 38**, Bao teaches that the etch stop layer is a SiCO-based composite deposition (Col 6 Ln 36-37).

With respect to **claim 13, 28, and 40**, Bao teaches that each of the first etch stop layer and the second etch stop layer is SiCN, SiCO, SiN, SiON, SiC, or a combination thereof (Col 6 Ln 34-38).

With respect to **claims 20 and 33**, Bao teaches that the second copper layer is a copper dual damascene structure (Fig. 5, 32).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 5, 19, and 32 rejected under 35 U.S.C. 103(a) as being unpatentable over Bao, in view of Lu et al (U.S. PG Pub #20020100693).

With respect to **claims 5, 19, and 32**, Bao teaches all of the limitations of claims 1, 14, and 29 respectively, and teaches that the etch stop layer is a SiOC layer (Col 6 Ln 36-37), but does not teach that the dielectric layer is a porous organo-silicate glass layer. Lu teaches a dielectric layer that is formed from OSG (Paragraph 13).

Claims 8, 9, 12, 22-24, 27, 35, and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bao, in view of Li et al (U.S. Patent #6753260).

With respect to **claim 12, 27, and 39**, Bao teaches all of the limitations of claim 11, 26, and 38, but does not teach that a first etch stop layer is a SiC film and the second etch stop layer is a SiO film. Li teaches a first etch stop layer is a SiC film (Fig. 1, 16 and Col 2 Ln 57), and a second etch stop layer is a SiO film (Fig. 1, 18 and Col 2 Ln 62). It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the etch stop layer of Bao with the first layer being a SiC film and the second layer being a SiO film as

taught by Li in order to enhance the moisture resistance and etching selectivity of the etch top layer.

With respect to **claims 8, 9, 22-24, 35, and 36**, Bao teaches all of the limitations of claims 7, 21, and 34 respectively, but does not teach a first etching selectivity $S1$ of the first etch stop layer to the dielectric layer, and a second etching selectivity $S2$ of the second etch stop layer to the dielectric layer satisfy the formula: $S1 \neq S2$, or that $S1$ and $S2$ satisfy the formula: $0 < S1 < S2$. Since Li teaches the limitations of claim 12 as shown above it is assumed that the materials described will meet the limitations of claims 8 and 9. It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the etch stop layer of Bao with materials wherein $0 < S1 < S2$ as taught by Li in order to improve the fabrication process of the device.

Claims 10, 25, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bao, in view of Kloster et al (U.S. PG Pub #20020140103).

With respect to **claim 10, 25, and 37**, Bao teaches all of the limitations of claim 7, but does not teach a first thickness $T1$ of the first etch stop layer and a second thickness $T2$ of the second etch stop layer satisfy the formula: $T2 < (T1 + T2) / 3$. An equivalent formula for this limitation is $T2 \leq (1/2)T1$. Kloster teaches a composite etch stop layer where the bottom layer (Fig. 1, 16) is less than half the thickness of the top layer (Fig. 1, 18 and Paragraph 39). It would have been obvious to one of ordinary skill in the art at the time the invention was made to

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make the composite etch stop layer of Bao with $T2 < (T1 + T2) / 3$ as taught by Kloster in order to create an optimal arrangement for etching.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben P. Sandvik whose telephone number is (571) 272-8446. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (571) 272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

bps



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